Space Weather Technical Forecast

Issued on Thursday, 02 November 2023 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of further M-class flares throughout. Active fluence expected 02-03 Nov.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Moderate with a peak flare of M1.4 at 01/1226 UTC. This is speculated to be from an unnumbered region that is now rotating onto the visible disc over the southeast limb. AR3474 in the southwest remains the largest region on the visible disc, but has exhibited some slight decay and separation of the large trailing spot during the period. Some minor growth and consolidation in the spots of AR3472 in the northwest appears to have ceased, with some recent decay of its numerous small spots. AR3473 and AR3476 have both largely decayed, with AR3477 showing little change in appearance. AR3478 and AR3479, both in the northeast were numbered, but remain magnetically simple at this time.

A filament eruption was detected around 02/0230 UTC from a region close to newly numbered AR3479 in the northeast. On initial analysis, much of the ejecta appears directed to the northeast, however it is currently being analysed by Enlil for any potential Earth-directed component.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 by ACE continue to slowly decline, as the high speed stream from coronal hole 66 moves towards the western limb, reducing from 450-480km/s to 400-420km/s during the period. Density has been below average. Total magnetic field strength, Bt, has been persistently weak, with the north-south component, Bz, also varying weakly. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet throughout.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux has varied between Moderate and High levels, with a peak of 2120 pfu at 01/1710 UTC. The associated 24-hour fluence exceeded the Active (1e8 integrated pfu) threshold at 02/1200 UTC, with 8.5e7 integrated pfu recorded at 02/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected, with a chance of further isolated M-class flares.

Solar Wind / Geomagnetic Activity: A CME that left the Sun late on 31 Oct may give Earth a glancing blow either late day 3 (04 Nov) or early day 4 (05 Nov). A further CME has been identified from a region in the northeast starting at around 02/0230 UTC. Much of the ejecta appears to be directed above Earth-orbit but the CME is currently being analysed by Enlil to confirm this. The high speed stream from coronal Hole 66 continues to ease, with solar winds soon becoming background from slightly elevated levels. No further significant enhancements are expected during the period in the absence of any CME effects. Geomagnetic activity is expected to be mostly Quiet, with a chance of isolated Unsettled intervals. Any potential arrival of the CME from 31 Oct could see activity increase to Unsettled to Active levels late on day 3 (04

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Nov) or early day 4 (05 Nov).

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background levels. High energy electron flux (greater than 2MeV) is forecast to oscillate between mainly Moderate and High levels in the coming days, but probably with a decreasing day-on-day peak. Electron fluence values are now just above the Active (greater than 1e8 integrated pfu) threshold and is expected to remain above this level on day 1 (02 Nov) and at least part of day 2 (03 Nov). There is a steady reduction in probabilities of exceeding the Active threshold in the following days.

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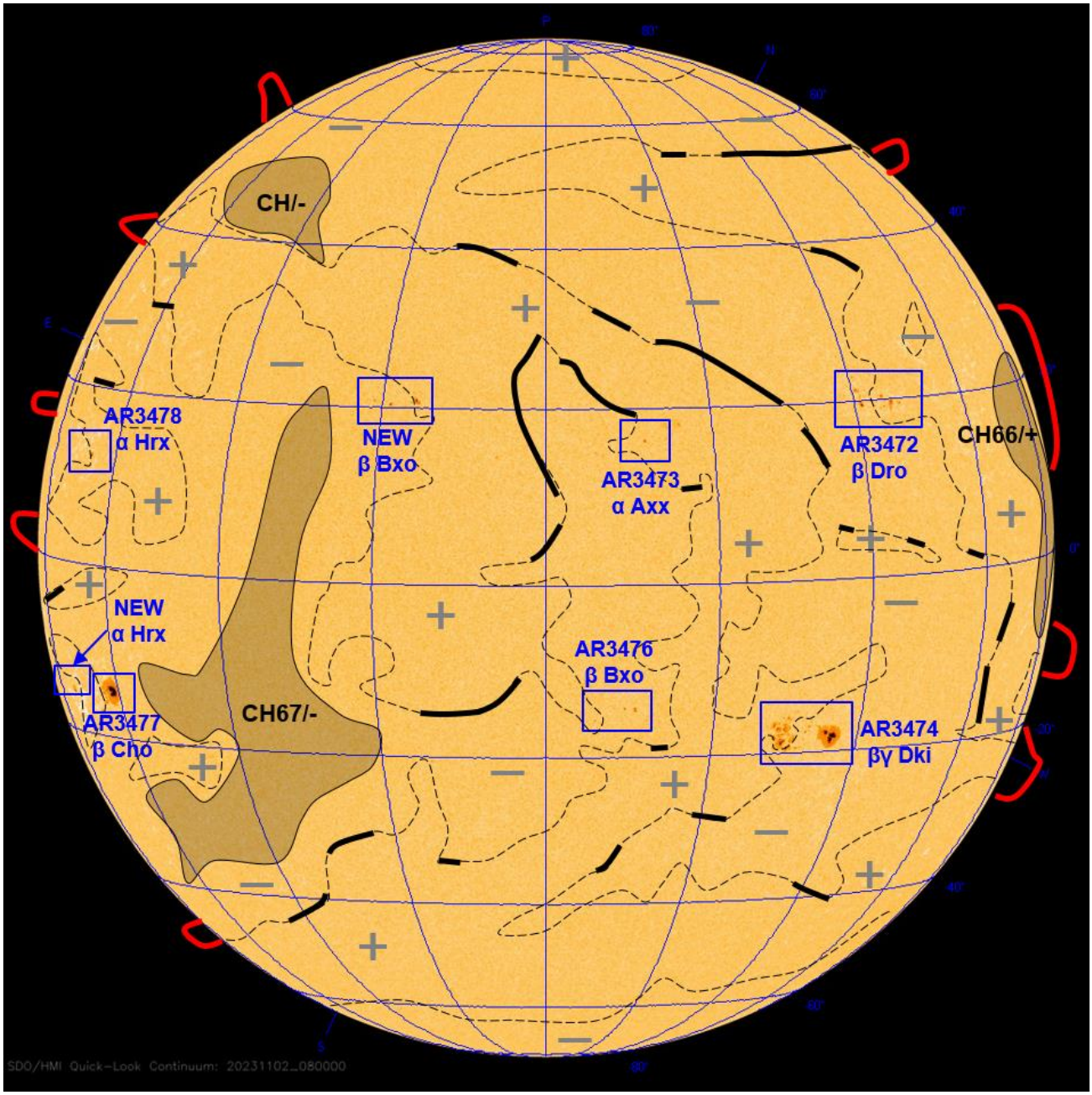
Figure 1. Solar Analysis Valid 02/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption from the southeast disc around 31/2200 UTC resulted in a CME that may give Earth a glancing blow either late day 3 (04 Nov) or early day 4 (05 Nov). A second filament eruption was detected around 02/0230 UTC from a region close to newly numbered AR3479 in the northeast. On initial analysis, much of the ejecta appears directed to the northeast, however it is currently being analysed by Enlil for any potential Earth-directed component.

Solar wind speeds have declined to around 400-420km/s as the effects of the high speed stream from CH66/+ continue to ease. No significant transient or recurrent coronal holes are forecast to connect with Earth within the forecast period with winds expected to fall to background levels later on day 1 (02 Nov).

Mainly Quiet geomagnetic activity is expected with a chance of isolated Unsettled intervals. Any arrival of the CME from late 31 Oct during the latter part of day 3 (04 Nov) or early day 4 (05 Nov) could see activity increase to Unsettled to Active levels.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections – Nil

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Radio Blackouts - X-Ray Flares:

There are eight sunspots on the visible disc. AR3474 in the southwest remains the largest group, although appears somewhat more disorganised as the large asymmetric trailer spot has decayed into numerous smaller spots. Few spots now occupy the intermediate part of the group, with a more open structure between the lead and trailer regions. AR3472 in the northwest has decayed somewhat, after some previous growth and consolidation of its many spots. AR3477 in the far southeast maintains a moderately large lead spot, but a fairly simple magnetic structure overall. All other regions are magnetically simple and largely inactive at this time.
A new region, considered responsible for the two M-flares on 01 Nov is currently rotating over the southeast horizon, but it is still too foreshortened in available imagery to make an accurate assessment at this time. GONG far-sided seismic signatures had previously suggested a strong active region and as such may present an uptick in flare risk in the coming days.
Low to Moderate solar activity is forecast, with a chance of further isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels, although there is a very slight chance of proton storms from AR3474 as it rotates into a more favourable location in the western hemisphere of the visible disc.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to continue to vary between Moderate and High levels initially as the solar wind pressure resulting from CH66/+ continues to subside. A gradual day-on-day decrease in diurnal maxima is probable during the period, with more persistently background or Moderate levels likely by days 3 and 4 (04-05 Nov).
Electron fluence has exceeded the Active (greater than 1e8 integrated pfu) threshold and is expected to remain above this level through the remainder of day 1 (02 Nov) and at least part of day 2 (03 Nov). There is still a chance of remaining above the Active threshold into day 3 (04 Nov), but should return below these levels by day 4 (05 Nov).

GEO Electron Environment	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	**≥ 2 MeV ≥ $1x10^{8}$**	Yes	100	80	40	10
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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Figure 2: GOES16 >2MeV Electron Flux (top) and MOSWOC Fluence forecast with recurrence (below)

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